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CONTENTS

	PAGE
Soil and Health	81
Review	83
Fowl Paralysis	83
Peasant Agriculture	84
Converted Rice	98
Soilless Culture of Plants	99
Chemical Notes	100

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SOIL AND HEALTH

IN an article published in *Food Manufacture** Dr. Hugh Nicoll draws attention to a recent debate in the House of Lords opened by Lord Teviot, which he thinks cannot be said to have greatly illuminated the subject of the relationship between soils and disease and health. "The allegations of Lord Teviot and of the Earl of Warwick and Lord Lymington received wide but not deep publicity in the daily press. Lord Teviot declared that "the soil suffering from the strain upon it has had to be boosted up with stimulants . . . . Surely crops doped with stimulants, dressings or sprays, cannot impart to those who partake of them resistance to disease if they have to b , if I may use the term, so much gingered up in order to exist".

"The tenor of the speeches of these noble lords" says Dr. Nicoll "was similar; it amounted to an uncritical anger against artificial manures and praise of "natural" ones; the whole supported by some rather disparate examples and much quotation of a few "authorities"—an authority being anyone of note who agrees that natural manures yield healthier crops, and thus healthier people and stock than do artificials. A wider reading of the "natural manure" thesis than is afforded by the report of the debate in the House of Lords suggests that while its exponents often adopt the scientific *form*—even to the extent of going in for experimentation—they have little of the scientific habit; it is notable how much they subsist by faith and testimony".

"Yet, in spite of the mysticism and bad reasoning with which the question of the relations between soil fertility and human and plant and animal health has been encumbered, there is a case to be answered. There can be few among us who will not support Viscount Bledisloe's plea, made in the same debate, to press very strongly upon His Majesty's Government that the time has come when there ought to be research—research not merely conducted in watertight compartments affecting on the one hand the health of plants, on the other the health of animals, and in the third place the health of human beings and some relation between the soil and all of them, but comparative research on the important problem of the inter-relation between the morbid conditions of soil, plant, animal and human beings."

* Vol. XIX, No. 1, 1944.

"We may doubt whether the outcome of such investigation will give much comfort to the "compost" theorists; it is more likely to underline the known necessity for ample provision of lime and phosphates and other inorganic material, for lack of which herbage and crops are prone to be of poor nutritive quality (low mineral content), and thus to predispose to animal disease and even to human malnutrition. Lord Bledisloe raised the question whether a cow grazed on pasture deficient in phosphate would transmit that deficiency to her milk. He said that he was informed that the cow would starve her own bone structure and constitution, to the detriment of her health and vitality, before there appeared a deficiency in the milk. This plain, non-mystical example suggests that the question of soil impoverishment is primarily a matter of more minerals for livestock. It would be interesting to see how far vaccines and inoculation are needed to sustain the resistance of cattle to disease if the cattle are fed from fields abundantly supplied with what is already known to be necessary".

"The Earl of Warwick, who incidentally referred to "those awful dehydrating plants being put up all over the country," was sure that if only we can keep the soil fertile disease can and will disappear in plant, in beast and in man. He pointed out that there is "really no such thing as scientific proof; there is only scientific probability". One feels that this was meant as a nasty one for the scientists, and that his lordship would be surprised to learn that the most percipient scientists would agree with him on that philosophic point."

"The most factual contribution to the debate was made by Lord Geddes, whose remarkable speech seems to have had little publicity. He devoted much of his time to expounding the demographic investigations of Dr. Enid Charles, who has recently examined the situation in Prince Edward Island. Here, there is a population of mainly British, Irish and French stock which maintains "a standard of health, a standard of well-being and a standard of reproduction which is unique among Western Europeans at the present time". The islanders live "very much as Lord Teviot has suggested we all should live, drawing their food fresh from the sea and from the field in the traditional manner, living upon simple foodstuffs". Until Lord Geddes presented these facts the compost authorities had always quoted the Hunzas, a Himalayan tribe, as the perfect example of man unspoilt by artificial conditions."

"As an example of cure, and not prevention, Viscount Bledisloe mentioned the improvement in the health of natives working in the copper mines of Northern Rhodesia. These mines are under the management of a company of which Lord Geddes is chairman. Originally under-nourished, the natives were poor specimens and had little heart for work, and their later efficiency was largely due to the fact that Lord Geddes had caused experiments to be made ("I believe not swayed solely by philanthropic motives but by economic considerations") to discover what is a properly balanced ration for the native."

"Given vitamin C in the form of citrus fruit, the native increases his output, said Lord Bledisloe, by 30 or 40 per cent., and if he is also given meat twice a week there is a gain of a further 30 or 40 per cent.; but a third allowance of meat in the same week is "found not to be strictly an economic proposition". There must be vast areas in which the vitality of the population is capable of some such improvement, and where "Joy through Food" would be an appropriate slogan. It would be understood, of course, that mere gluttony should be ruled out: what is wanted is quality and balance."

"Another oversea problem is the loss of topsoil through erosion, which is due to unsuitable cropping and inadequate return of organic matter to the soil. Here, too, the remedy is known, and it is mainly economic and social conditions that prevent its application. The compost propagandists of Britain tend to confuse erosion with the evils of soil intoxication, which they allege are in evidence due to the use of artificials. Soil erosion is not a serious problem in Great Britain, but ill-informed propaganda against the use of artificial manures may easily set a problem. The cause of our soil distress at home is not that the soil is being intoxicated, but that it is being frequently starved. Propaganda intended to rule out the use of artificial manures is to be deprecated, since it may embarrass the post-war policy for which most of us hope—namely, the raising of soil fertility by every available and rational means."

Referring to "the many misunderstandings that arise through inexpert discussion of the relationship between soil fertility and human well-being" Dr. Nicoll states that the fundamental misunderstanding seems to be that a vaguely expressed "quality" of human food depends directly upon the soil—this "quality" being often identified with vitamin content. The available evidence suggests that the vitamin content of plants is largely, indeed almost wholly, independent of the manuring of the soil and of its treatment with organic matter; thus plants and crops grown in proper nutrient solutions containing no soil or organic matter are, as far as we know, fully equal to those grown with the aid of organic manures. Nor, apparently, have organic manures necessarily a singular beneficial influence upon plant disease; plants grown under rational conditions of soilless culture on the large scale have been free from the common diseases of the same crops grown in the field."

"The principal nutritional function of compost and animal manures is to keep plant nutrients in circulation. The old agricultural leases which insisted on periodical dunging of the land and forbade the sale of straw and dung off the farm were founded upon a practical if unconscious appreciation of this. The ideal agricultural sales-policy of those days was sound. It was expressed n the saying that 'the crops should all walk to

market'. To-day, however, thanks to artificial supplements, it is no longer needful to observe these old practices in their full rigour, though the rules of good husbandry still apply. In particular, it is essential not to deplete the soil of inorganic nutrients such as lime, phosphate, and the minor elements; and it is essential for other reasons to keep up the stock of organic matter in the soil. The organic matter in the soil may be maintained by several methods, including the incorporation of a ley in the rotation; but during the operations of farming there is nevertheless a constant drain of inorganic elements even if nothing more than meat leaves the farm. The diminishing balance can be kept in circulation by intensive composting of plant residues; but the stock of nutrients can only be increased from outside the farm."

"This is the nub of the organic *versus* inorganic question. It will be seen that it is a rather futile subject for controversy. Yet we should like to see experiments begun on animal health in relation to soil fertility. We do not doubt that they would add considerably to our knowledge. As Lord Lymington said in the debate: "If there is more than a shadow of suspicion that our methods are wrong, we cannot afford to wait". Under modern conditions the simple cycle of nutrients on the land has been broken, and the average farmer has not learnt how to restore it rationally or is prevented by economic causes from doing so. There is reason to suspect that the usual medical and veterinary approach—with its insistence on the infective agents rather than on the agents that build up resistance to infections is wrong. So it will be surprising if the two great industries of agriculture and food do not energetically pursue a matter of such high importance to both of them."

REVIEW

Plant Viruses and Virus Diseases (2nd revised edition). By F. C. Bawden. pp. 294. (Waltham, Mass; The Chronica Botanica Co.; London, W. 1; Wm. Dawson and Sons, Ltd., 1943). $4.75 U.S.

The revised edition of this book provides an up to date summary of the literature on plant viruses. The author has not attempted to give detailed descriptions of the symptoms produced by individual viruses, or their host ranges, but has discussed the subject as a whole, the text being supplemented by many excellent illustrations. Due to the rapid progress made in certain aspects of the subject since the appearance of the original edition, all the chapters have been modified to a greater or lesser extent. The writer gives a full account of the internal and external changes induced in the host plant by certain viruses, and a discussion of transmission is followed by a consideration of the relationship between the viruses and their insect vectors. The alteration of some viruses in a manner suggestive of a genetical mutation, resulting in the production of numerous strains, is described together with the acquired immunity found in some cases. Of particular interest is the account of the purification of certain virus nucleoproteins and their chemical, physical and serological properties, a subject to which the author has made a noteworthy contribution. In view of their increasing importance to tropical workers, and the special problems their study presents, it is unfortunate that the writer has devoted comparatively little attention to the viruses attacking tree crops. A chapter is devoted to the metabolism of infected plants, and the movement of viruses within the host. The author outlines the properties which he considers should be made the basis of virus classification, but has wisely refrained from evolving any additional system of nomenclature. Notes are given on control measures, and the book ends with an interesting discussion of the theories regarding the origin and multiplication of viruses. The book should prove of value to all those interested in plant viruses.

W.T.D.

FOWL PARALYSIS

Fowls are liable to a disease which leads to the paralysis of their wings and legs. In some flocks a large percentage of the birds may be affected. Until recently, it was believed that the disease did not attack fowls until they were over three months old. Its true nature was not discovered until F. Blakemore, of Cambridge University made investigations with young chicks, which were found to be highly susceptible to the disease. Professor Dalling of the Veterinary Laboratory at Weybridge in England has now shown that fowl paralysis is a phase of an acute infectious disease of young chicks, which is caused by a filterable agent or virus. In the young chick the agent is found mainly in the liver and the heart muscle.

Depending on the virulence of the agent the infected chicks may die soon after infection or may recover, remaining in an unthrifty condition and failing to attain normal weight over a period of months. Infection with an agent of very low virulence may fail to cause any appreciable change in the young chick. At a later age—usually five to six months—fowls infected as chicks may develop characteristic symptoms of fowl paralysis.

There is also some evidence that families of fowls vary in their susceptibility to infection. The disease can be eliminated from a flock by breeding from survivors for a few generations, but the resulting progeny remain susceptible to the infection. Infection is conveyed by infected excreta and it has been shown that infected fowls may pass the filterable agent through the egg. (*Monthly Science News*, No. 11.)

PEASANT AGRICULTURE

An Economic Survey of the Las Lomas District, Trinidad

BY

C. C. PARISINOS, C. Y. SHEPHARD AND A. L. JOLLY

(This survey was carried out by C. C. Parisinos, Colonial Office Agricultural Scholar, as a part time exercise, during the first six months of 1943. His original dissertation is available in the College Library. The questionnaire used was an abbreviated and modified version of those employed in the survey of peasant agriculture in the Leeward and Windward Islands, previously conducted by the Department of Economics. A. L. Jolly and C. Y. Shephard are responsible, in the present article, for condensing the original dissertation, and, in a few instances, for drawing wider inferences.)

Description of the Area

LOCATION AND TOPOGRAPHY

The area is situated in the County of Caroni in the ward of Cunupia, and is bounded on the west by the Madras Settlement Road (about 3 miles east of the Southern Main Road), on the north by the Caroni River, on the south by the Cunupia River and on the east by the Arena River. The land rises from 25 to 50 feet above sea level in the north and west part of the area and to about 200 feet in the south-eastern corner. Almost half the area is flat, low-lying land, and half is hilly; the district takes its name from the hilly part, Las Lomas (" the hills ", Spanish).

SOILS (1)

In order of agricultural merit, the four chief soil types are respectively:—(i) Sangre Grande Silty Clay (2), (ii) Talparo Clay, (iii) Piarco Sand-on-Clay, (iv) Arena Sand. All four are highly acid (pH about 4.6) and deficient in lime. Most of the Sangre Grande Silty Clay land was formerly under cacao, but has now largely been rented to peasants for growing cane or rice. It is graded III (" not satisfactory ") for cacao by Dr. Chenery: the available phosphate content is low and potash medium-low. The Talparo clay is normally very deficient in available phosphate but often contains relatively large amounts of available potash. It is graded IV for cacao, but III or IV for cane. Most of the land comprising this type of soil is owned by peasants who cultivate it on the bush fallowing system, the common proportion of time under crops varying from perhaps 20 to 50 per cent. on the different phases of the type. The two sandy types both contain 70 or 75 per cent. of sand and have an index of texture of zero; they are deficient in both available phosphate and available potash. The best phase of the Piarco Sand-on-Clay is barely cultivable (grade V for either cacao or cane), and is sometimes used for shifting cultivation but otherwise these sands are either left in forest or, if cleared, provide rough grazing.

RESIDENCE

The hilly area in the south-east is the healthiest but the least useful from the point of view of agriculture. The north-western corner around the village of St. Helena is the most intensively cultivated and thickly populated part of the district. There is a pipe-borne water supply in the village of St. Helena, but elsewhere the people depend on water caught from house roofs during the rainy season, and on springs or wells during the dry season. Springs and shallow wells are numerous on the Arena and Piarco Sands and make these soil-types attractive for house sites. The well sites are usually situated at a lower level than the habitations and easily become polluted. There are no springs or wells in the areas occupied by the Sangre Grande and Talparo Clays, and some of the people suffer seriously from shortage of water, especially during the dry season, when the nearest source of supply may be a mile or more away. The rainfall averages about 85 inches a year over the western Las Lomas district.

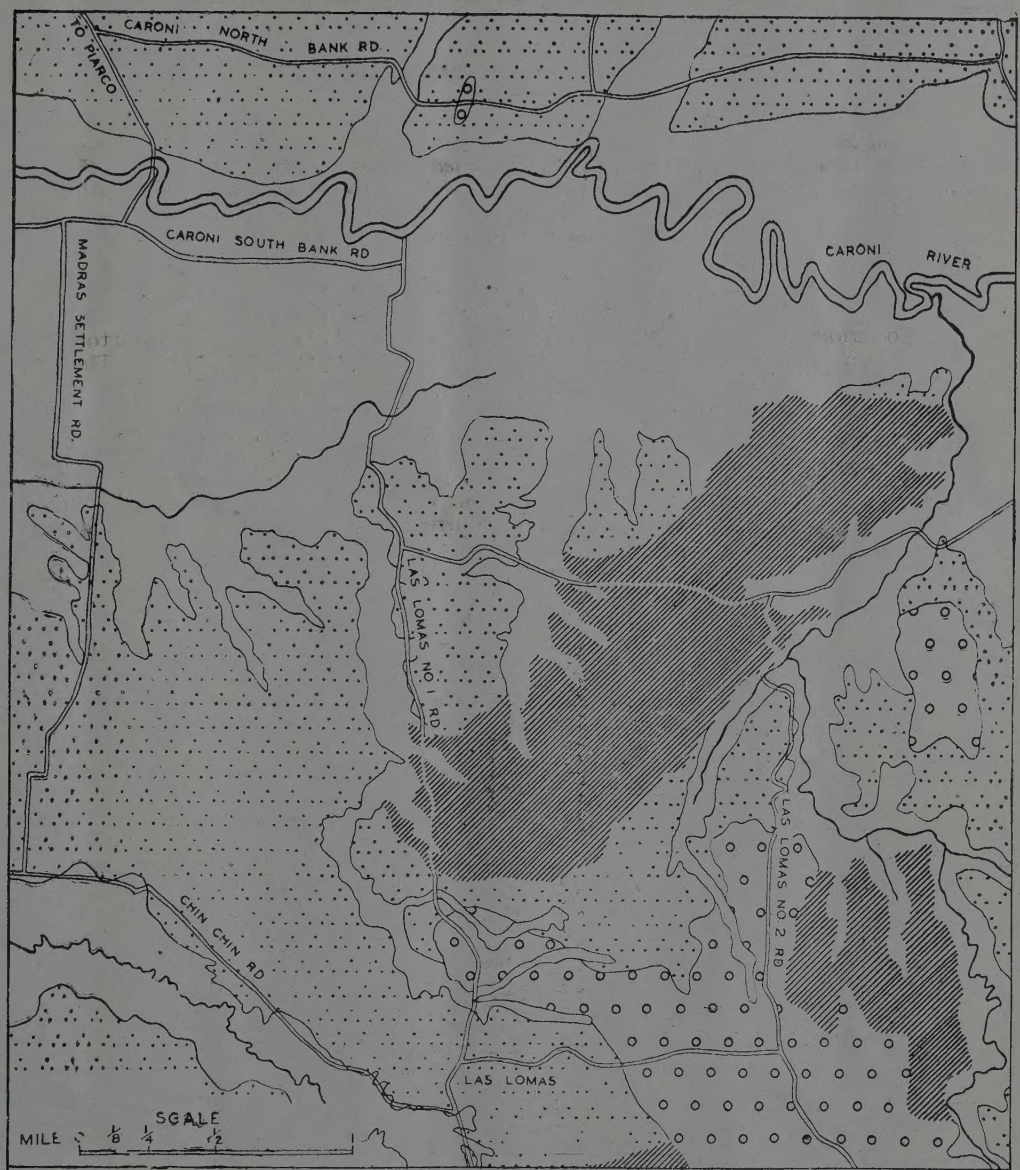
COMMUNICATIONS

The area is well supplied with main roads, but secondary roads and agricultural traces (earth roads) have been neglected, and many become impassable during the wet season. The cane buying station maintained by the Caroni Sugar Company near St. Helena gives the cane farmers near this village a great advantage. The only omnibus route in the area is along the Caroni Road. The nearest railway stations are at Caroni and Cunupia, some 4 to 5 miles to the west of the area.

(1) See, " A Provisional Classification of the Soils of Trinidad ", F. Hardy, *Tropical Agriculture*, 17 (1940), 153-158, and " Application of the Mitscherlich Pot Test for Determining the Nutrient Status of Some Trinidad Peasants' Soils ", J. W. Jordan, Unpublished Dissertation, Imperial College of Tropical Agriculture, 1943. Studies of these soils are being continued by the College Department of Chemistry and Soil Science. A full description of the field characteristics of the soil types is given in the original dissertation.

(2) This soil is widespread in the vegas of rivers of the Northern Plain of Trinidad, comprising the Caroni and the Oropouche systems, and the Sangre Grande basin. Recent estimates show that it occupies some 50,000 acres of land, of which 27,000 acres are in cacao, the rest being chiefly in second-bush or farmed by peasants.

SOIL MAP OF LAS LOMAS DISTRICT



LEGEND

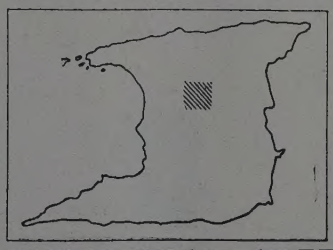
1 Sangre Grande Silty - Clay

2 Piarco Sand - on - Clay

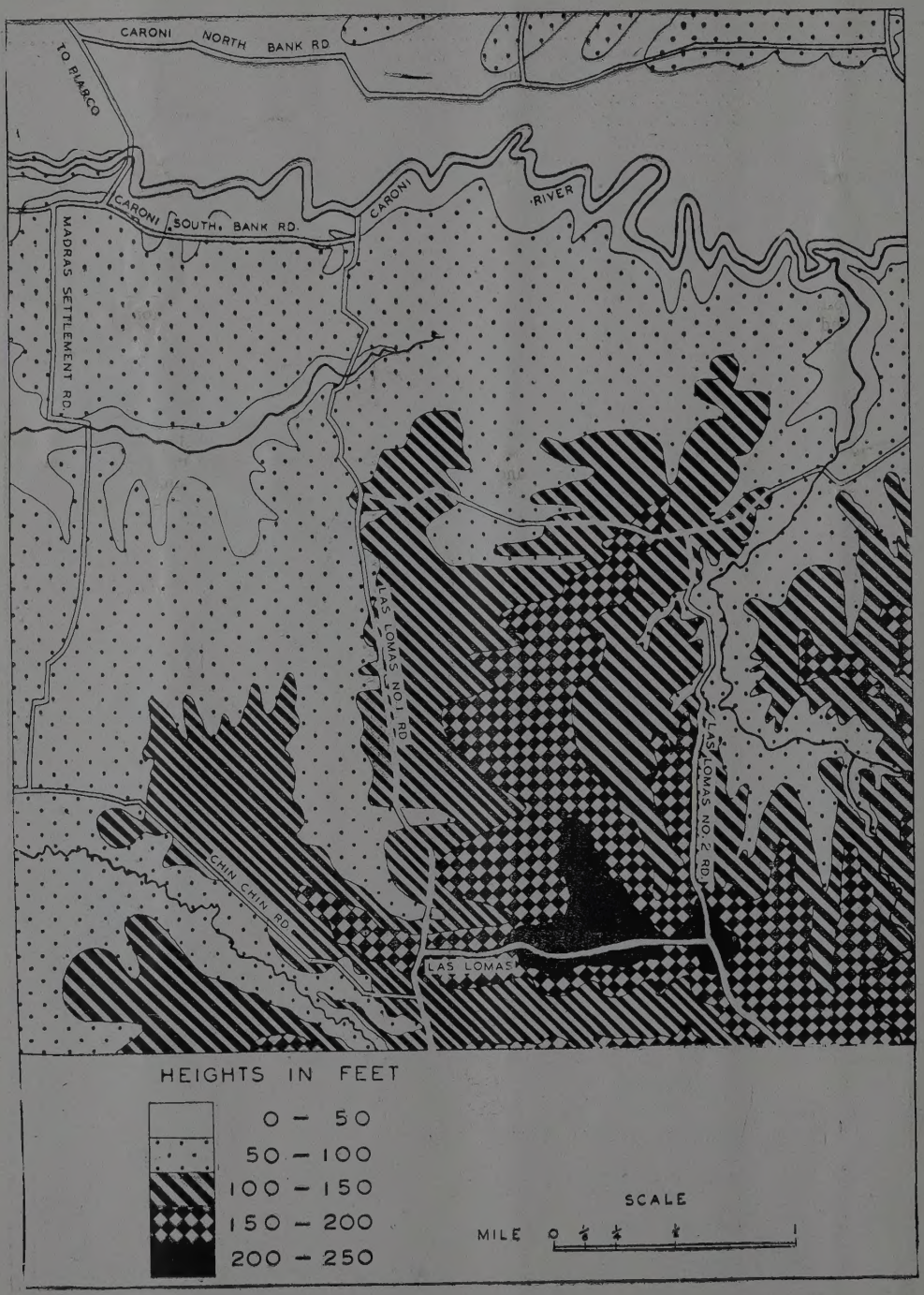
3 Arena Sand

4 Talparo Clay

(After E.M. Chenery, 1942)



RELIEF MAP OF LAS LOMAS DISTRICT.



THE PEOPLE

Most of the people are of East Indian descent, except along the Chin-Chin Road where half the population is West Indian. Most of the East Indians are Hindus, but there are some Mohammedans and some Christians. Hindu customs are observed, and weddings and other festivities are frequent during the cane cutting season. The farmer who prospers considers it a social and religious duty to invite his neighbours to prayers and supper. The normal expenditure on such a supper is of the order of $20 to $30, but a rich farmer may spend $50 or even $100(3). Three-quarters of the population were recorded as illiterate at the last (1931) census, but now it is the exception rather than the rule for children not to attend school, either at St. Helena, or at Las Lomas villages.

EFFECT OF THE WAR

The data relate to the twelve months' period, July 1st, 1942, to June 30th, 1943. In more normal times, the majority of the families divided their time between cultivating their holdings and working for wages on sugar and cacao estates in the vicinity. During the period under review, however, the construction of military bases provided abundant and relatively highly paid employment, both in the immediate neighbourhood and in more distant parts of the Island. The exodus of many able-bodied men from rural areas to the bases made charcoal-burning a highly profitable enterprise for those who remained. Trinidad depends, more than most tropical countries, on imported supplies of rice, flour, pulses and salt fish, and a temporary dislocation of supplies caused distress in this area from June to August 1942. At the time of the survey the peasants were paying increasing attention to the production of ground provisions and rice, both for home consumption and for sale. Some four hundred acres of derelict cacao land along the Caroni Road were rented from estates by Government and sub-let to peasants at a nominal rental of $1 per acre per annum (4), for the purpose of growing food. This additional area relieved the pressure of population which had become acute around the village of St. Helena. The price of sugar cane, the principal cash crop, showed only a small rise relative to that of ground provisions and to the level of wages. Hence, only a small area was planted in sugar cane during 1941/2, and none at all during 1942/3; the cultivation of ratoon canes was entirely neglected.

CLASSIFICATION OF FAMILIES

Data were collected from 78 peasant families. The families were classified according to the amount of land cultivated. Group A, the "small" farmers, cultivated at least one acre but less than 3 acres; Group B, the "medium" farmers, cultivated at least 3, but less than 5, acres; and Group C, the "large" farmers, cultivated at least 5 acres.

Table 1

Size of Holding*

Group	Acres cultivated	Number of farmers	Per cent. of total farmers	Mean acreage cultivated
A ...	1-2.99	35	45	2.13
B ...	3-4.99	28	37	4.05
C ...	5-10.00	15	18	6.54
		78	100	3.66

* Holdings of less than 1, and more than 10 acres were excluded from the survey.

MAN-POWER

The number of persons constituting the family, the number of dependents, and the number of workers is least among the small farmers, and greatest among the large farmers. The number of available working days per annum has been calculated in terms of man-days, using the following scale:

	Man-days per Annum	
	Man	*Woman*
18 years and over	312	208
14 years and over but under 18	156	104
12 do do. 14	78	62

Persons totally incapacitated were excluded from these calculations, and adjustments were made for persons partially disabled.

Table 2

Family-Man Power

Per family	A Small farmers	B Medium farmers	C Large farmers	All farmers
No. of persons	4.42	5.57	6.73	5.28
No. of dependents	1.74	2.32	2.93	2.18
No. of workers...	2.68	3.25	3.80	3.10
Total no. of man-days (12 months)	639	796	933	752

UTILISATION OF LABOUR

Nearly a third (29 per cent.) of the man-days was spent in outside employment, a small proportion (5 per cent.) was lost through sickness, and about one-fifth (19 per cent.) was occupied in house work. Thus, approximately half (47 per cent.) the man-days was available for work on the holding, though by no means all these man-days were so employed.

(3) The Trinidad dollar = 4s. 2d. sterling. One cent = ½d. sterling.

(4) The standard rental for cacao land in this area is $10 an acre.

Table 3

Utilisation of Labour

Per family	A Small farmers	B Medium farmers	C Large farmers	All farmers
Total man-days	639 (100%)	796 (100%)	933 (100%)	752 (100%)
Man-days on outside work	195 (30%)	218 (27%)	254 (27%)	216 (29%)
Man-days lost through sickness ...	29 (5%)	36 (5%)	69 (8%)	39 (5%)
Man-days on housework	146 (23%)	144 (18%)	151 (16%)	145 (19%)
Man-days available for work on holding ...	269 (42%)	398 (50%)	459 (49%)	352 (47%)

Outside Employment

Only 5 per cent. of the families are exclusively farmers. Half of the families earned wages ranging from $100 to $300, and three-quarters of them earned between $100 and $500 (Table 4). One-third of the 105 wage earners were employed principally at the military bases, one-sixth worked for other farmers, and another sixth for charcoal burners. Employment on neighbouring estates, the principal source of wages before the war, attracted less than a tenth of the wage earners (Table 5). The income from wages averaged $280 per family and accounted for half the gross income, three-fifths of the gross cash income and three-quarters of the net cash income (Table 6). Wages, especially from the bases, formed an important part of the income of most families. The main constructional work at the bases is, however, now complete, and thousands of labourers have been laid off. Farmers in this, and in other areas, will now have again to depend more on their own holdings and on estate employment than they did during 1942/3.

Charcoal Burning

One-third of the families were charcoal burners. Charcoal burning is the principal occupation of many families at Nancoo, Las Lomas and Mahaica, but it was only a subsidiary source of income among the families included in the survey. Very little of the charcoal came from agricultural land, for an acre of 10 to 15 years' old lastro (bush) yields only 1 or 2 cords (5) an acre. High forest, by contrast, will give 30 to 40 cords an acre. The land remaining under forest in this district is very infertile, and after felling it is either

(5) A cord of wood (8′ × 8′ × 4′) will yield 30 to 40 bags of charcoal, each worth 60 cents to 75 cents wholesale, or 85 cents retail.

Table 4

Earnings per Family from Outside Employment (July 1942-June 1943)

Earnings in $*	Number of Families: A Small farmers	B Medium farmers	C Large farmers	Total	Per cent. of Total families
Nil ...	2	1	1	4	5
1- 50 ...	1	—	—	1	1
51-100 ...	2	2	2	6	8
101-200 ...	8	12	2	22	28
201-300 ...	12	4	1	17	22
301-400 ...	4	3	3	10	13
401-500 ...	3	1	5	9	12
501-600 ...	1	2	—	3	4
601-700 ...	1	—	—	1	1
Over 700 ...	1	3	1	5	6
Total ...	35	28	15	78	100

* $1.00=4s. 2d. sterling.

Table 5

Nature of Outside Employment

Employment	No. of persons employed	Per cent. of persons employed
Military bases ...	36	34
Other farmers ...	18	17
Charcoal burners ...	18	17
Estates	9	9
Carting and haulage (other than cane)	7	7
Roads	6	6
Miscellaneous ...	11	10
Total	105	100

* Classified according to principal employment only.

Table 6

Wages from Outside Employment (July 1942 to June 1943)

Per family	A Small farmers	B Medium farmers	C Large farmers	All farmers
	$	$	$	$
Income from wages	253	296	314	280
Gross income from all sources* ...	451	637	771	579
Gross cash income	370	494	599	459
Net cash income†	310	405	437	369
Wages as percentage of:				
% Gross income ...	56	47	41	48
% Gross cash income ...	68	60	52	61
% Net cash income	81	73	72	76

* Including produce consumed in household.

† Gross income less expenditure on hired labour, rent of land, etc.

Table 7

Labour Hired

Average rate of expenditure on hired labour per acre of:	A Small Farmers		B Medium farmers		C Large farmers		All farmers	
	Expenditure $	Per cent. of gross income*	Expenditure $	Per cent. of gross income*	Expenditure $	Per cent. of gross income*	Expenditure $	Per cent. of gross income*
Cane	15	22	10	17	14	24	13	21
Rice	32	44	24	36	22	34	26	38
Ground provisions	7	18	1	5	3	8	3	10
All crops	16	26	11	19	13	23	13	23

* Expenditure as percentage of gross income derived from that crop.

abandoned or, less frequently, cultivated in ground provisions for a season though seldom longer. A man can earn $2 or more net a day from charcoal burning, but the work is arduous; the pits require attention several times a night, and the need for water to extinguish the fire limits production in most places to the rainy season.

HIRED LABOUR

The families themselves furnish the greater part of the labour for cultivating their holdings, but the great majority of the farmers (95 per cent.) hire assistance at various times of the year for the heavier jobs, such as ploughing and levelling rice fields, threshing rice, cutting and carting sugar cane. The mean expenditure per family on hired assistance was $48. (Table 7)

LAND TENURE

Most of the land now cultivated by peasants was formerly under estate cacao. The sale of the hilly and less fertile areas to peasants commenced about 1923, when the first serious slump in Trinidad cacao prices had shaken the confidence of planters. The more fertile vegas of the Caroni River remained in cacao until 1940 when a combination of witches' broom disease, low cacao prices and high wages induced planters to rent land to peasants for the cultivation of sugar cane. No formal lease is drawn up (6) but the peasant is entitled to compensation for the unexhausted value of his cane cultivation if required to quit. Cases of eviction are exceedingly rare. The landlord contracts with the sugar factory for all the cane grown on his land and organises cane deliveries. The sugar company pays the landlord a bonus of 24 cents per ton of cane for the service he thus renders. The landlord collects the proceeds of all the cane from the factory and deducts the rent due when paying individual farmers (7).

(6) Formal leases are also rare among peasants in the Leeward and Windward Islands.

(7) Some such arrangement for securing the payment of cash rent is also customary in the Leeward and Windward Islands.

Table 8

Tenure of Land

	A Small farmers	B Medium farmers	C Large farmers	All farmers	Per-cent. of total
No. of farmers who:					
Own all their land	6	2	0	8	10
Both own and rent land ...	8	12	9	29	37
Rent all their land ...	21	14	6	41	53
Rented land as per cent. of land cultivated by peasants ...	73	78	77	77	
Freehold land as per cent. of land controlled by peasants ...	57	70	48	60	
Rents per holding for:	$ c.	$ c.	$ c.	$ c.	
Land ...	12.04	21.05	36.75	20.00	
House lot ...	2.89	3.00	3.16	3.00	
Total ...	14.93	24.05	39.91	23.00	
Total rent per cultivated acre ...	$ c. 7.01	$. c. 5.94	$ c. 6.10	$ c. 6.29	
Total rent as per cent. of gross income from crops and livestock	8	7	9	8	

Most of the rice land is owned by a few peasants who rent plots to their neighbours.

The standard annual rental for newly felled cacao land is $10 an acre. Rice land is rented at rates equivalent to from $8 to $10 an acre.

"Hard land", i.e. land which has been cultivated in sugar cane or ground provisions for many years, can be rented for $5 an acre. Land on higher ground, usually under 'lastro' (bush), is rented at from $3 to $4 an acre. Most of the families own a house, but many do not own the house-site. The rent for a standard house lot (50 ft. by 50 ft., or approximately 1/18th of an acre), exclusive of house tax and water rates, is $5 in St. Helena and $3 to $4 elsewhere. A few of the wealthier peasants own several house sites and some of them have adopted the practice of renting cane-land from cacao estates and sub-letting it to other peasants, primarily, it would seem, because paying out the proceeds of the cane affords a convenient means of collecting rent due on account of house sites. Rents per family averaged $23 ($20 for land, $3 for house lot) which is equivalent to $6.29 per acre under cultivation and to 8 per cent. of the gross income from the holding (i.e. excluding wages earned). (Table 8)

Ten per cent. of the families own all their land, 37 per cent. own part and rent part, and 53 per cent. rent all their land. Nearly two-thirds (64 per cent.) of the land controlled by the peasants is owned by them, but much of it is of poor quality and cultivated on a bush fallowing system.

The existing form of cash tenancy does not provide a satisfactory foundation for the development of peasant agriculture. The tenant has no security of tenure and is thereby discouraged from identifying his welfare with that of the soil. There is no inducement for him to establish his home on the land. The cacao planters have become landlords by force of economic circumstances rather than by inclination, and the reverses which the cacao industry has suffered during the past twenty years have left them with inadequate capital for the provision of water supplies, service roads, main drainage systems, etc.

Fragmentation of Holdings

The land controlled by these 78 families is divided into 253 separate parcels. Nearly half (45 per cent.) the families reside on the land, but the greater part of their cultivated land is some distance from their houses. In India, holdings have been gradually divided into fragments by practices associated with the Hindu law of inheritance. Among East Indians in Trinidad, the holding has been built up in fragments by acquiring one parcel after another as the opportunity arose. Cacao land could be purchased recently at $100 an acre, but few families could afford to buy such land to an extent sufficient for their needs. Many families (37 per cent.) bought a small area, usually of cheaper land, and added other parcels as and when the various cacao estates in the district offered land for rent. Thus, the separate parcels of cultivated land are often a mile or two from the house and, not infrequently, in different directions. (Table 9)

Table 9

Fragmentation of Holdings

No. of parcels of land	A No. of small farmers	B No. of medium farmers	C No. of large farmers	No. of all farmers	Per cent. of all farmers
1 ...	5	1	—	6	8
2 ...	11	4	1	16	21
3 ...	12	10	4	26	33
4 ...	6	9	5	20	25
5 ...	1	3	2	6	8
Over 5 ...	—	1	3	4	5
Per cent. of farmers resident on one of their parcels ...	43%	54%	33%	45%	—

This district is exceptional in that undivided residential holdings would be undesirable for the reason that the swamp rice plots provide breeding grounds for the Anopheline mosquito, the female of which is the vector of the malarial germ (8). Hence, two parcels, one the homestead and the other the rice plot, would be desirable, but three or more parcels, the majority with no resident cultivator, constitute an impediment to sound agricultural practice. Much time and energy is absorbed in merely proceeding to and from the plots. Most (86 per cent.) parcels of land are unattended by night, and many by day, and this facilitates the depredations of the praedial thief (9). The animals are usually housed at night near the peasant's home and the bulky farmyard manure, if used, would have to be taken in most cases long distances to the field. The peasants prefer to live in a village, where shops, the school, and other amenities are easily accessible, and especially in a village such as St. Helena where a pipe-borne water supply is available for man and beast. The development of a sound and intensive system of peasant agriculture is dependent, *inter alia*, upon the provision of undivided holdings which afford convenient access to simple but essential amenities. The provision of water, to mention but one of these essential amenities, may, however, be an expensive undertaking.

Land Utilisation (10)

The 604 acres of land controlled by these 78 peasants may be divided into three groups, (i) cultivated land, (ii) grazing grounds, (iii) bush

(8) Nine per cent. of the children at one school and 8 per cent. at the other, have enlarged spleens.

(9) All the many complaints of theft made by peasants in the Leeward and Windward Islands Survey related exclusively to land on which the family did not reside.

(10) A large scale map in the original dissertation shows the distribution of individual crops, grazing grounds and bush within each of the holdings surveyed, but it contains too many details for small scale reproduction.

and forest. A little less than half (47 per cent.) of the land was cultivated during 1942/3, a small portion (6 per cent.) was devoted to grazing, and nearly half (47 per cent.) was in bush or forest of various ages. There is a striking difference between cash-rented and freehold land in respect of the proportion cultivated. Practically all (over 99 per cent.) of the rented land was cultivated, for the peasant seldom rents land which he does not intend to cultivate. By contrast, only one-sixth (17 per cent.) of the land owned by peasants was cultivated by them during 1942/3, though this was only partly due to the bush fallowing system.

MANURING

Much of the rented land was under cacao until recently, and the débris of leaf and root litter, and of felled immortelle and cacao trees endows it with a transient fertility. The presence of tree stumps has precluded the use of animal drawn implements. No manure of any kind is applied to cacao land which, when planted in cane, will ratoon to the satisfaction of the peasant for ten or more years unless weakened by fire, froghopper or water-logging. It is only after the land has been under sugar cane for many years that the peasant resorts to the use of farmyard manure, artificials or lime. "Hard" land gives only two or three ratoons. The factories to which the peasants sell their cane used to supply farmers with sulphate of ammonia on credit, and its use was steadily increasing, but none was available during the year under review owing to the War.

These 78 peasants own or control 150 "cattle units" with which about 750 tons of farmyard manure per annum could have been manufactured. Such a supply would have permitted a dressing at the rate of over 2½ tons per cultivated acre. Only one-sixth of the farmers, however, applied any farmyard manure at all during the year. Some of the animals (chiefly cows) are grazed on one or other of the three small agistment grazing grounds in the district, but many are stall-fed. The floors of the sheds are generally scrupulously cleaned every morning. In the village of St. Helena, where the accumulation of manure heaps is prohibited by the sanitary authorities, the droppings and trodden grass are either thrown into the river, or burnt, or buried. Elsewhere the manure is usually either thrown into high bush, or allowed to accumulate until rain washes it away.

There are several excuses which the peasant can offer for not utilising farmyard manure. The separation of livestock from the land makes transportation difficult. Nearly two-thirds (65 per cent.) of the farmers own carts, but many traces are impassable during the wet season, and carts are prohibited from traversing rented land during the rains, while in the dry season, farmers' carts are fairly regularly engaged in carting cane. Out of the 78 farmers, 35 reside on one piece of the agricultural land. Out of these resident farmers, only 8 applied farmyard manure; and out of the 43 non-residents, six applied it. Out of these six non-resident farmers, two actually hired carts for carrying manure. Transportation difficulties thus hardly appear to be the main reason why so few farmers used farmyard manure.

The incorporation of farmyard manure into the soil undoubtedly would be difficult and laborious among the débris of recently felled cacao, and also in the case of ratoon cane. Even on "hard" land the peasant rarely tills the soil before planting cane. Most peasants acknowledge that farmyard manure increases the yield of sugar cane, but they are convinced that this addition is insufficient to compensate them for the trouble of manufacturing, transporting and applying manure. A few peasants offered the excuse that farmyard manure depressed the yield of cane. The consensus of opinion favoured the view that ground provisions required no manure.

BUSH-FALLOWING

Most of the farmers consider bush-fallowing the most convenient and cheapest method of restoring the fertility of the soil. The land is quickly prepared by burning the bush, stumps limit erosion but also prohibit the use of an animal drawn plough, and crops are planted without preparatory cultivation. Permanent cultivation would involve manuring, and, in the hilly areas, soil conservation measures as well. Considerable damage is occasioned to forest and cane cultivation by careless burning of bush. Bush-fallowing remains practicable only in those areas where land is plentiful, and must give way to some more permanent system of cultivation as the pressure of population on the land increases.

GRAZING

The grazing grounds are permanent, and are confined to those sandy soil-types that are considered unsuitable for cultivation. Grazing grounds are established by cutting down the bush and 'brushing' the weeds with the cutlass once or twice a year. Savannah grass (*Axonopus compressus* Beauv.) usually predominates on grazing grounds.

Crops

Sugar cane, rice and ground provisions are the principal crops grown by peasants in this district. Trees such as mango, orange and coconut are grown by a few peasants around their houses. Many farmers possess a small kitchen garden in which melongenes, ochroes, tomatoes, etc., are grown (Table 10). All farmers grew some ground provisions, though some (25 per cent.) grew them only as catch crops among sugar cane. The great majority also grew sugar cane (90 per cent.) and rice (93 per cent.). Only one farmer grew nothing but ground provisions (Table 11). Sugar cane occupied 59 per cent. of the cultivated

land, rice 21 per cent., and pure stands of ground provisions, 20 per cent. The large farmers devote but little more of their land (66 per cent.) to sugar cane than do the 'medium' (53 per cent.), and 'small' farmers (56 per cent.)

Table 10

Cropping

Crops grown in pure stands *i.e.*, excluding catch crops	A No. of small farmers	B No. of medium farmers	C No. of large farmers	No. of all farmers	Per cent. of total farmers
Mixed provisions only ...	1	—	—	1	1
Cane and provisions only ...	2	2	—	4	5
Rice and provisions only ...	3	4	—	7	9
Cane and rice only ...	12	5	3	20	26
Cane, rice, and provisions ...	17	17	12	46	59
Total ...	35	28	15	78	100
Cane ...	31	24	15	70	90
Rice ...	32	26	15	73	93
Provisions (pure stands)* ...	23	23	12	58	74

* N.B.—All the remaining farmers grew ground provisions as catch crops.

Table 11

Land Utilisation and Crop Income

	Cane	Rice	Provisions
Percentage of cultivated acreage under ...	59	21	20
Acres per holding of ...	2.14	.75	.73
Per cent. of gross crop income derived from	56	22	22
Gross income in $ derived from ...	128	50	50

Sugar cane is the only cash crop of importance grown by these peasants, the bulk of the rice and ground provisions being consumed by the family. Thus, sugar cane accounted for 86 per cent. of the receipts in *cash* from crops. When, however, rice and ground provisions consumed are evaluated at the same prices as similar produce sold, it is seen that sugar cane accounted for 56 per cent. of the gross income from crops, and that the remainder was shared equally by rice and ground provisions. Some of the income credited to ground provisions is derived from land in sugar cane.

The gross income from crops averaged $228 per family, and $58 per acre under cultivation(11). The large farmers derived an average income of $404 from crops, the medium farmers $240 and the small farmers $143. The small farmers secured only a slightly greater income per acre cultivated—viz. $67, compared with $59 for medium farmers and $61 for large farmers—and thus the family gross income from crops is very closely related with the amount of land under cultivation.

Sugar Cane

ESTATES (12)

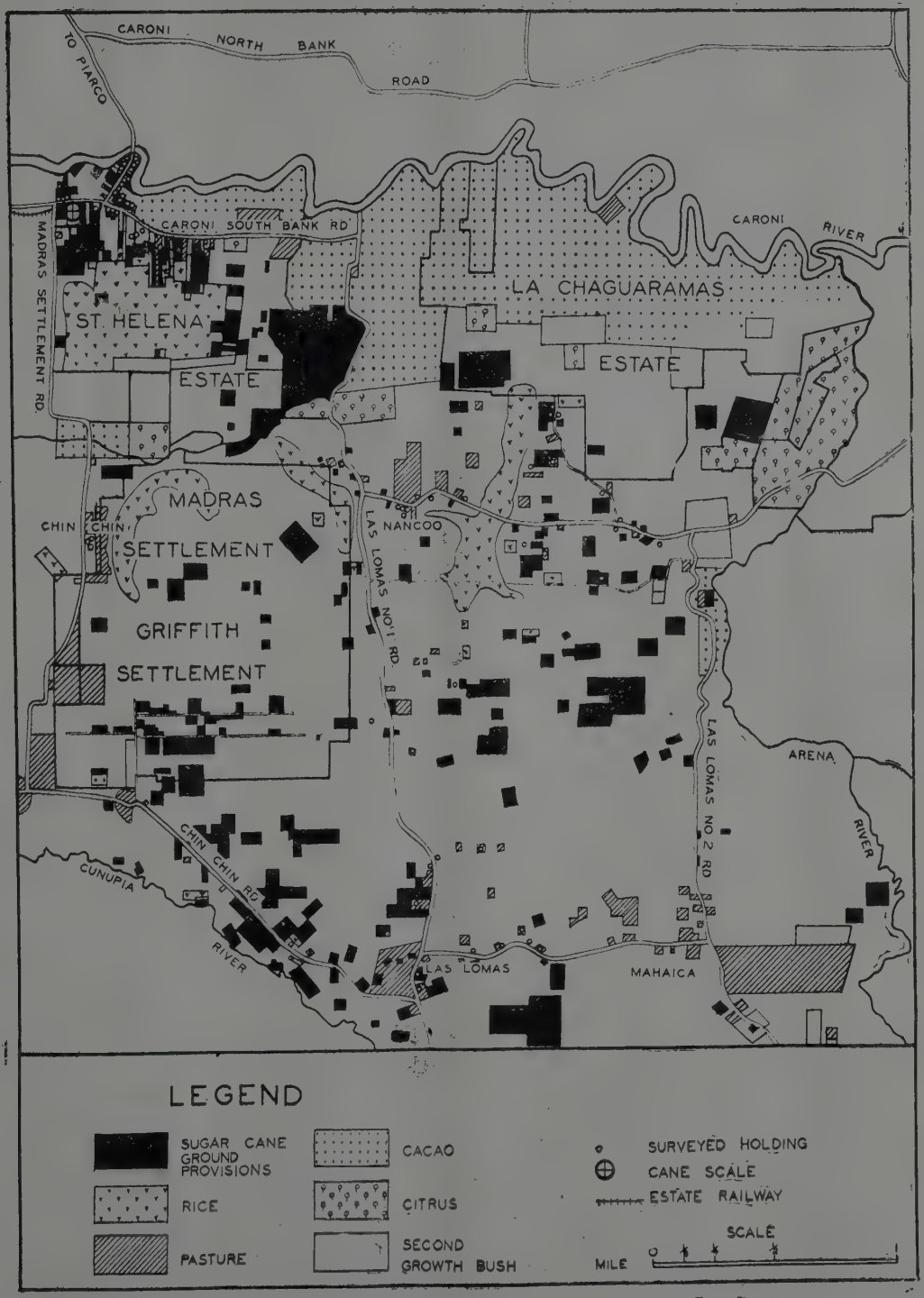
There are important differences between the cultural practices of estates and those of these peasant farmers. The estates usually plough the soil by mechanical means to a depth of about 12 inches during the dry season (January to June). Parallel cane beds, 22 feet or 24 feet from centre to centre, are separated by drains sunk six inches or more below the ploughing depth. A camber is given to the cane beds, usually by mechanical means, to assist the run-off of rain during the wet season. Cane setts are planted in pairs in furrows, four to six inches deep, made either by mechanical means along the bed for dry season and early wet season planting, or by hand across the bed for wet season planting. Farmyard manure is placed in the furrows at the rate of about 15 tons per acre. The furrows are partially refilled with earth (the 'first breaking of banks'), when the young plants begin to tiller, and their leaves to broaden (about 6 to 8 weeks after planting). The furrows are completely refilled (the 'final breaking of banks') about 4 to 6 weeks later. The land is subsequently weeded at intervals (three weedings are customary) until the canes close in. The first crop (plant cane) is reaped between 15 to 24 months after preparatory cultivation is commenced.

After harvesting the plant-cane, the trash (if not burnt) is removed from the immediate vicinity of the ratoon stools and ranged between the rows. Artificial fertilisers (usually sulphate of ammonia at the rate of 3 cwts. per acre, though, more recently, increasing quantities of potash and phosphate were being applied according to varying soil requirements) are scattered around the stools as soon as possible after reaping the previous crop. The drains are cleaned at the beginning of the wet season. Tillage of ratoon canes is not generally practised, the principal expenditure being on the three weedings.

(11) This gross crop income per acre was two or three times as large as the corresponding income of peasants examined in Antigua, Nevis and St. Vincent, but the two periods are not comparable, the Leeward Island's data being unaffected by war. Cane yields in Trinidad were very similar to those obtained in Antigua and Nevis, and the main cause of this difference in gross income was the higher prices obtained, more especially for rice and ground provisions, by the Trinidad farmers.

(12) See Turner, P.E., Methods of Agriculture in Standard Use on Sugar Estates in Trinidad, C.P. No.1 of 1944, Govt. Printer, 35-38.

CROPPING MAP OF LAS LOMAS DISTRICT



Thus, on estates much more labour is required for the cultivation of plant-cane than for ratoon canes. For example, for the 1943 crop on a representative estate, expenditure on cultivating(13) plant-cane averaged $85 an acre, and for ratoons, only $9. On an average, two ratoon crops are reaped and the field is then replanted or fallowed. Thus, in the normal 4-year cycle, 3 crops are reaped, or, in other words, about ¾ of the acreage under cane is reaped in any given year.

PEASANTS

A distinction may be drawn between cane cultivation on cacao land and on "hard" land in lastro. On *cacao land*, the weeds are cutlassed and the cane is planted in "cup holes". The cacao trees and immortelles are then felled (landlords prohibit burning). The smaller débris is ranged between the rows of cane. One or two months after planting, the weeds are cleared and the canes are moulded up. Two further weedings are normally given before reaping the plant-cane. Ten or more ratoons may be taken from newly felled cacao land. The peasant prefers extensive supplying of dead stools to replanting the entire area.

In the case of land under lastro, the bush is burnt and the cane planted without further preliminaries. Normally only two ratoon crops are taken from such land, which is then allowed to revert to bush.

Most of these peasants plant cane in April or May, while the estates plant in July—September. There are several reasons why the peasants prefer dry season planting. The clearing of lastro by hand is considered too expensive, and the less laborious method of burning the standing bush is possible only in the dry season. At harvest time, the tops of cane provide suitable planting material, and saleable cane need not be sacrificed, as is inevitable in wet season planting. A crop of cane planted in April or May is usually reaped during the next dry season; and thus the peasant reaps practically all his cane-land every year, instead of only three quarters of it, as is the case on estates. (This difference should be borne in mind when comparing peasant and estate yields, for only the acreage actually reaped is usually reckoned when calculating yields). Most peasants interplant cane with ground provisions (catch crops were obtained from 48 per cent. of the land under cane during 1942/3).

When sweet potatoes are grown on cane-land, special banks are constructed for them, the cane being planted in the furrows. After the potatoes have been lifted, the canes are earthed up with the soil from the potato banks. Apart from this, cane-land is not tilled.

(13) *i.e.* Excluding reaping ($25 for plant, and $18 for ratoon, canes), manures ($20 for plant, and $11 for ratoon, canes), and all overhead expenses. See C.P. No. 1 of 1944, Govt. Printer, Trinidad, Table IV, p. 47.

YIELDS

The yield of all these peasants' sugar-cane fields (plant and ratoon together) averaged 12½ tons per acre in 1943. On a large neighbouring estate, which we may call X, yields averaged 15 tons per acre in the same year (Table 12). In both cases, yields were considered low that year (Table 13). It will be noted that farmers, unlike the estate, obtained a much lower yield from plant-canes than from ratoons, presumably because the farmers' plant-canes are so much younger than those of the estates (Table 14).

Table 12

Sugar Cane Yields (1943)

	A Small farmers	B Medium farmers	C Large farmers	All farmers	X estate
Tons of cane per acre ...	14	12	12	13	15

Table 13

Sugar Cane Yields (1940-43)

Year	X Estate Tons per acre
1940	13
1941	19
1942	15
1943	15

Table 14

Plant and Ratoon Canes (1943)

Mean yields in tons of sugar cane per acre	PEASANTS			X Estate
	Sangre Grande silty clay	Talparo clay	Piarco sand clay	
Plant cane	9	7	8	21
1st ratoon...	16	16	11	11
Other ratoons	14	11	9	10

The importance of Sangre Grande Silty-Clay to these peasant farmers is illustrated by the fact that 81 per cent. of the cane area reaped was on that one soil-type. Most of it, as already noted, was recently under cacao. Talparo Clay and Piarco Sandy-Clay (a phase of Piarco-Sand-on-Clay), although extensively represented in the district, were relatively unimportant, and each accounted for only about 8 per cent. of the area of cane reaped. The remainder (3 per cent.) of the cane area was divided equally between Las Lomas Sand-on-Red-Mottled Clay, and Moruga Loam, of which only small areas occur in this district.

The 'small' farmers obtained the highest yield per acre, but the 'medium' and 'large' farmers had more land under cane. The mean total outputs of sugar cane were: 'small' farmers, 16 tons; 'medium' farmers, 25 tons; and 'large' farmers, 51 tons.

MARKETING

The cane farmer has no choice as regards the purchaser of his cane, for, by mutual agreement, the factories have delineated the areas within which each will buy cane. Most of the Las Lomas district lies within the sphere of the Caroni factory, and only that portion which is situated to the south of the Chin-Chin Road is served by the Woodford Lodge factory. Each seller of cane must enter into a contract with a factory. The contract specifies the approximate quantity of cane, the variety of cane and other details. The landlord serves as the contractor for tenants on former cacao estates. The minimum price of cane is uniform throughout the island, and is calculated by means of a complicated formula in which the price of sugar is the chief variable.

A representative of the factory visits each contractor in November or December and estimates the production of sugar cane. The factory authorities, having decided the rate at which cane should be delivered, issue cutting permits accordingly. When the contractor is a landlord, he is given a daily allowance by the factory, and he apportions cutting permits between his tenants.

The crop season is regarded as the busiest of the year and yet, paradoxically, it is one in which much time is spent in enforced idleness. Small farmers are permitted to deliver one ton of cane per day, and, as they desire to make sure of selling all their crop, there is usually congestion around each buying scale. On many days, numbers of loaded carts are left overnight near the scale; others arrive early in the morning, and a long queue is formed. The farmer may have to wait most of the day to deliver a single load of cane (14). The waste of man- and animal-power in the aggregate is enormous. Nearly two-thirds (65 per cent.) of these farmers own draught animals and carts, but some produce more cane than they can transport with their own animals. Transportation is a very serious matter for these farmers who have no carts, for the cost will amount to between $1.30 and $1.50 per ton of cane from fields near the scale, and to as much as $2.00 from distant fields (15). This charge for carting may appear excessive to the producer in comparison with the price received for cane ($4.80 in 1943), but it does not appear so to the carter, when he is able to handle only a ton a day. On estates, by contrast, carters using their own carts and animals were paid 45 cents per ton, and drivers using estate carts and animals 22 cents a ton; but such men commonly handle 6 tons of cane in a day. The organisation of cane deliveries by farmers is one of the largest labour problems of the sugar industry. The present position in this matter is a serious handicap to cane cultivation and is also undoubtedly largely responsible for the increasing prevalence of cane fires.

Burnt cane deteriorates rapidly, and, when a cane fire has occurred, fresh cane is not accepted at the scale until the burnt cane has been harvested and delivered. The factories paid 60 cents (16) per ton less for burnt cane than for fresh cane with the object of discouraging the peasant from setting fire to his cane. A fire is a great temptation, however, to the farmer who has no cart of his own. Since the delivery of other cane is temporarily stopped, many reapers and carts become available for cutting and carting his cane, and he may complete his season's harvest in two or three days.* He is then at liberty to accept employment elsewhere instead of having to spread his harvesting over several weeks. To such farmers the penalty of 60 cents a ton may not prove an effective deterrent.

On the other hand, to the cane farmer who wishes to harvest and transport his crop with his own family labour and cart, a cane fire may be a calamity. Given at the most three days in which to reap and cart his cane, he must hire additional labour and carts. The cane he delivers is penalised in price, and that which he cannot reap in time is a complete loss. It is alleged that many such fires are set with the malicious intention of harming the cane farmer.

Cane fires, if numerous, dislocate the work of other farmers, because they are unable to continue reaping their cane until the burnt cane has been delivered. Thus, as a result of fires, chaos may be introduced into what is in any event a very complicated problem.

The problem of the orderly harvesting and delivery of cane cannot be solved by the factories only, but experience in Trinidad has shown that a farmers' Co-operative society can handle it.† There is only one Co-operative society in the Las Lomas district, and that was recently formed, and concerned solely with credit.

Rice

Rice ranks first in importance among the crops grown by these peasants for family consumption. Rice is a staple article of diet among both East and West Indians in Trinidad, but the Island's production, estimated at 6,000 tons in 1936/7, falls far short of requirements, and, before the War, about 20,000 tons were imported annually, mainly from Burma (17). A great majority (93 per cent.) of the farmers grew rice, but very

(14) Large farmers, usually those producing 100 or more tons of cane per annum, are given special permits entitling them to proceed to the head of the queue.

(15) An allowance of 24 cents per ton of cane is paid by the factory to farmers for canes carted more than 3 miles.

* Factories are not obliged to accept cane burnt more than 3 days previously.

† *e.g.* The Debe Co-operative society.

(16) The penalty was $1 in previous years.

(17) Customs Report.

few (3 per cent.) sold any, and many families supplemented their domestic production by purchase. Rice is not grown on an estate scale in Trinidad; practically all of it is produced by East Indians for their own consumption. The area of rice cultivated by these peasants averaged ¾ an acre, ranging from ½ acre among small farmers to 1 acre among large farmers.

The peasant gives greater cultural attention to his rice than to any other crop. None of the rice land in the district is at present irrigated, and the crop is entirely dependent on rainfall. Preparations are begun only when rain has rendered the soil sufficiently moist to work easily which is seldom before June, and sometimes later. The weeds are cutlassed and removed immediately before ploughing or forking. The few farmers who own a plough and a team of oxen undertake ploughing for other peasants, charging at the rate of $12.50 an acre. Many farmers own one ox, but only a few of them co-operate to pair their oxen for ploughing. Plots which are too small to plough are laboriously hand forked.

The land is harrowed one to three weeks (depending on rainfall) after ploughing or forking, and immediately afterwards levelled and puddled by the hoe (18). In the meantime, seedlings are grown in a nursery. The nursery bed is forked or ploughed and worked by hoe into a fine tilth (19). Cow dung and sulphate of ammonia are sometimes applied to the seed bed. The seed is sown dry and the seedlings are planted out when 20 to 45 days old, depending on the degree of saturation of the rice fields. Young seedlings are preferred. The seedlings are planted out, usually in July, in clumps of from 4 to 9 plants, spaced 8 to 12 inches apart. The field is hand-weeded one to two months after planting, and may require a further weeding in years when the rainfall is so deficient that the surface of the field is uncovered for considerable periods.

Harvesting is usually spread out over several weeks during November—December. The rice is cut, by means of a sickle, about 6 inches above ground, the sheaves being heaped on the bunds of the field, or on some other conveniently situated raised ground. Threshing is done by hand on tables, usually in the field. Sun-drying and winnowing are generally carried out at home. Each family stores its own paddy and has it milled, usually at the St. Helena mill, as and when required.

Yields of paddy averaged 2,100 lbs. an acre(20). Production per family averaged 1,000 lbs. by small farmers, 1,900 lbs. by medium farmers and 2,300 lbs. by large farmers, having a gross value of $34, $59, and $72 respectively, per family. The rice crop, however, is one on which considerable expenditure is incurred for labour, rent, etc., and nearly half (47 per cent.) of the gross value was paid out in cash (38 per cent. for labour and 10 per cent. for rent) (Table 15). Small farmers spent an average of $15 on labour, medium farmers $21 and large farmers $25, with an overall average of $19.

(18) An additional weeding may become necessary if a long interval occurs, through inadequate rain, between ploughing and harrowing.

(19) Nurseries vary considerably in size, averaging about 1/35th of an acre. The seed rate for planting an acre of rice is about 50 to 60 lb.

(20) Rice land is usually measured in "quarters", and "jimmies". A "quarter" is approximately 0.80 acre. *i.e.*, one-quarter of a quarree (3.20 acres). A "quarter"=4 "jimmies", an acre=5 "jimmies". Paddy yields are calculated in terms of barrels (of 160 lbs. each) and kerosene tins (6 of which=1 barrel).

Table 15

Net Income from Three Crops (Per Holding)

	Cane	Rice	Provisions
Acre per holding ...	2.14	·75	·73
Gross income (sold)	$127.79	.15	$13.66
do. (consumed)	—	$50.19	$36.40
Rent	$12.98	$4.86	$2.16
Hired labour ...	$26.50	$19.04	$2.63
Net income ...	$88.31	$26.44	$45.27
Net income as per cent. of gross income	69%	53%	89%

Rent accounted for $3 (small farmers), $6 (medium farmers) and $7 (large farmers). Ploughing is usually paid for. Planting is generally completed in a day or two, but different farmers usually pool their labour, and the hiring of labourers for this purpose is uncommon. Labour is sometimes hired for cutting rice, but more often for the more laborious process of hand threshing. Wages were commonly $1.50 to $2.00 a day for a man. An estimate is given in Table 16 of the number of man- and animal-days required for the cultivation of an acre of rice, and, if we evaluate family labour at current rates, then the result shows a substantial loss (21). Rice is such

Table 16

Labour Requirements of Rice Cultivation

Per Acre	Man-days	Animal-days
Cutlassing and weeding ...	10	—
Ploughing and levelling ...	4	4
Nursery	5	—
Planting	10	—
Weeding	7	—
Harvesting and threshing	20	—
Carting	1	1
Winnowing	1	—
Total	58	5

(21) Data relating to the Imperial College of Tropical Agriculture farm suggest an even greater loss. Paterson, D. D., Cultivation Costs and Labour Requirements for Crops Grown in the College Farm, *Tropical Agriculture*, 19 (1942), 104-115.

an important article of diet among East Indian peasants that, even before the War, when imported supplies were abundant and cheap, there was great competition for rice land, and the departure of labour to the rice lands in July was always a factor with which cacao and sugar estates had to reckon. During the War, rice has been irregular and short in supply, and peasants attach even greater importance than usual to rice land.

Ground Provisions

Before the War, it was the general practice of peasants in the Las Lomas District to grow ground provisions for family consumption, but very rarely for sale, and only unexpected surpluses were sold. The production of sugar cane and cacao, and wage payments by estates, offered more remunerative employment, and Trinidad as a whole was more heavily dependent upon imported food than any other British West Indian island(22). The steep rise in the prices of ground provisions, and the impossibility of purchasing adequate and regular supplies, have induced peasants in this district to grow more ground provisions not only for family consumption, but also for sale. Thus, one-quarter (27 per cent.) of the value of ground provisions raised represented sales during 1942/3 (Table 15), and many peasants had planned to make ground provisions their principal cash crop during 1943/4 (23).

During 1942/3, 20 per cent. of the land cultivated by these peasants was occupied by ground provisions alone, but an additional 27 per cent. of the cultivated land consisted of cane cultivation with ground provisions (mainly cassava, corn, pigeon peas and sweet potatoes) grown as catch crops, from which an average income of $17.48 per acre was obtained (compared with $35.71 for sugar cane). Every farmer grew some ground provisions.

Land is seldom devoted to a single food crop, and is usually planted in a mixture of which maize, black-eye pea, cassava, and pigeon pea are the principal constituents, though others, such as tannia, eddoe, tomato, melongene, sesame, bodi and hill rice, may also be included. Sweet potatoes are grown by most peasants, but usually on separate and specially-prepared banks with other crops in the furrows. Few peasants grow yams, which require deep cultivation and abundant humus for good yields. In addition to these field crops, the peasant usually has a very small kitchen garden near his house, in which he grows such crops as tomatoes, ochroes, melongene and peppers. The kitchen garden is usually of little importance.

(22) Imports of food, drink and tobacco into Trinidad in 1937 averaged £4 3s. per head of population, compared with an average of £2 5s. for other British Caribbean colonies.

(23) The planting subsidy and the proposed higher minimum price for sugar cane may have affected these plans.

Maize is normally used as a poultry feed, but in this particular year an unusually large proportion was consumed by the family or sold as green corn. Maize is seldom stored for long because of damage caused by the grain weevil. The high prices offered for green pigeon peas (in the pod) tempted many peasants to sell. The island-wide shortage of tubers encouraged 'marchands' from the village and towns to buy crops in the ground, and this new practice, coupled with mixed planting and catch cropping, makes it impossible to calculate the yields of individual food crops. Collectively they were valued at $50 per holding (Table 15) (the same as rice), varying from $31 among 'small' farmers to $83 among 'large' farmers. Very little expenditure (mean $2.63 per holding) was incurred on hiring labour for the cultivation of ground provisions.

Livestock

All except two of the peasants kept livestock. Different types of animals have been converted into "cattle units" (Table 17). Most farmers (80 per cent.) have at least one cattle unit, and an appreciable proportion (39 per cent.) at least two cattle units. The average is 1.94 cattle units per family. The mean number of cattle units increases with the size of the farm, but not proportionately. Thus, whereas the 'small' farmers have 0.69 cattle units to each acre in cultivation, the 'large' farmers have only 0.39 (Table 17). It has been tentatively suggested by one of us elsewhere (24) that the West Indian peasant mixed farmer should maintain a minimum of one cattle unit for each acre of field crops, and it will be seen that these peasants fall short of that standard. It has already been shown, however, that only one farmer in eight used farm-yard manure, and so the majority have no claim to be termed mixed farmers.

Table 17

Livestock

Cattle units per holding	A Small farmers	B Medium farmers	C Large farmers	All farmers
Draft animals ...	0.51	0.75	1.33	0.76
Cows and calves ...	0.83	1.23	1.03	1.01
Other animals ...	0.14	0.22	0.18	0.17
Total	1.48	2.20	2.54	1.94
Total per cultivated acre	0.69	0.54	0.39	0.53

Draught Animals

These are kept by two-thirds (65 per cent.) of the farmers, primarily for the purpose of carting their cane to the buying scale. The 'large'

(24) C. Y. Shephard, "Survey of Peasant Agriculture in the Leeward and Windward Islands" (in preparation).

farmers, who sold on an average 51 tons of cane, can find fairly steady employment for a draught animal during the crop season, and all except one has a cart. The 'medium' farmers produced 26 tons of cane, and 71 per cent. of them had draught animals. The 'small' farmers sold only 17 tons of cane on the average, but half (49 per cent.) of them had carts. Some of the 'small' and 'medium' farmers carted cane and other produce for other farmers, but the majority considered it more profitable to work at the military bases. They maintain draught animals because of the difficulty of hiring them, but if the transport of cane was organised on a more rational basis, these farmers could reduce their head of stock, or substitute more profitable types of animals. Three of the 78 families have yokes of oxen which they use for ploughing rice fields. The bull (or less often the bullock) is the principal draught animal, with the mule and horse in a minority (30 per cent.). The cow is never used for draught purposes.

Draught oxen are usually given concentrates only when working, while mules and horses receive them all the year. The rations vary from farmer to farmer, but an ox usually receives from 2 to 6 lbs. of linseed meal, (25) and up to ¼ gallon of molasses a day (26). Expenditure on concentrates and molasses averaged $19 per draught animal for the year, but for mules and horses, which are given bran and oats, the expenditure was $50. Draught animals accounted for 39 per cent. of the total number of cattle units.

Cows and Calves

Sixty per cent. of the farmers had a cow or a calf, or both. The retail trade in milk is negligible. The nearest wholesale market is 5 to 8 miles away, but one enterprising farmer in the east of the district organises the collection and transportation (twice daily) of milk for his neighbours. The eight farmers in the survey who sold milk received amounts averaging more than $100. Most of the farmers with milch cows sold no milk but consumed it either fresh or in the form of ghee. No milk was produced on more than half (60 per cent.) of the holdings, and such milk as these families bought was invariably imported tinned milk.

The yield of milk per cow is low, averaging about 135 gallons per lactation period. Milch cows are usually fed 2 lbs. linseed meal per day, and 1 gallon of molasses per week, the expenditure averaging $15 per cow. Dry cows and calves are given no concentrates or molasses.

Fourteen per cent. of the farmers tended cattle on a share basis. The terms are commonly as follows: the owner (usually a 'large' farmer) places a heifer in the charge of a 'small' farmer. The 'small' farmer keeps the first calf and the owner receives the second. If the owner resumes possession of the heifer, he pays the farmer from $1.50 to $2.00 per mensem for maintenance. In other cases, one person buys an animal which the 'small' farmer tends until sold, when the increase in price is shared equally.

Grazing Grounds

There are two grazing grounds of about 60 acres each (one near Chin-Chin and the other near Mahaica), and a smaller one of about 14 acres near Nancoo village, where the peasant may graze his cow for an agistment fee of $2 for the first month, and $1.50 for each subsequent month. These grazing grounds are owned by 'large' farmers (excluded from the survey) who themselves maintain livestock in large numbers. The grounds are fenced and weeded.

The shortage of fodder and grazing during the dry season is generally one of the principal factors limiting the number of livestock kept by West Indian peasants. It is interesting in this connection to observe that, whereas the Chin-Chin and Nancoo grounds carry approximately 1 cattle-unit an acre all the year round (apart from a fluctuating population of peasant cattle), that at Mahaica carries 1 cattle-unit to 2 acres. Cattle on the Chin-Chin and Nancoo grazing grounds are allowed to graze part of the day during the dry season on neighbouring rice land, and are also given cane tops or Uba cane. There is neither cane nor rice land near the Mahaica grazing ground, and the dry season is one of anxiety to man and beast.

Many of the peasants set aside a small portion (about ½ acre) of their holdings as a permanent grazing ground; the great majority of them are cane-and-rice farmers. They claim that feeding their animals is less troublesome during the dry season, when cane-tops and grazing on rice land are available, than during the wet season, when women and children have to collect fodder from waste land and roadsides.

The bulls at Chin-Chin and Mahaica are half-bred Friesians, but a pure bred Friesian from the Government Stock Farm was also available for peasant cows at Chin-Chin. Bulls on the small grazing ground at Nancoo are working Zebus. Many peasants prefer Zebu stud bulls because the young bulls fetch good prices for draught purposes. Friesian bulls are preferred by peasants breeding for milk.

Cows and calves account for 52 per cent. of the cattle-units kept by these peasants. Draught animals, cows and calves together represent 91 per cent. of the cattle units (Table 17).

Goats and Pigs

East Indians are not fond of goats, and only one farmer in five (22 per cent.) kept one. Goats are invariably sold, and are neither milked nor slaughtered by these East Indian farmers. None of the peasants kept sheep (28).

(25) 4 cents per lb.
(26) 14 cents per gallon.
(27) 36 cents per gallon of milk.

(28) The owner of the Chin-Chin grazing ground, however, maintains a flock of 35 sheep.

Only one farmer in twelve (8 per cent.) kept pigs, the majority of those who kept them being West Indians and the remainder Christian East Indians. Pigs are fed on grass, mangoes, breadfruit and bananas obtained from the holding, and on oil-meal, rice, bran, and other concentrates bought at the shop.

Poultry

Almost every farmer keeps poultry, mainly for family consumption. They are fed on domestically-produced corn, rice and kitchen refuse. Mongoose and manicou sometimes decimate the chick population.

Income from Livestock

The gross income from livestock averaged $71 per family, divided almost equally between sales and family consumption. The 'medium' farmers received a larger average income ($100) from livestock than did the 'small' ($55) and 'large' ($53) farmers, principally by reason of greater sales of cows, calves and draught animals. The large farmers consumed a greater proportion of their livestock products than did other farmers.

The peasant regards his livestock, among other things, as a savings bank on which he can draw in a financial emergency, and the individual family's income from the sale of livestock will accordingly vary substantially from year to year. Twenty-two of the 78 farmers sold a cow, calf, draught animal, goat or pig during the year, while 6 bought draught animals and 6 bought cows or calves. The large farmers as a class bought more animals than they sold.

Table 18

Income from Livestock

Per holding	Small $	Medium $	Large $	All $	Per cent. of Livestock gross income
Milk and ghee consumed	7.33	20.60	19.80	14.67	21
Eggs and poultry consumed...	15.16	26.67	24.27	20.86	30
Total consumed...	22.49	47.27	44.07	35.53	51
Milk sold ...	15.62	13.08	—	11.80	17
Pigs and goats sold...	.17	1.07	2.03	.95	1
Cows and calves sold	9.08	23.40	—	12.28	17
Draught animals sold ...	5.00	11.96	—	6.68	9
Eggs and poultry sold	2.56	3.50	6.90	3.84	5
Total sold...	32.43	53.01	8.93	35.55	49
Gross livestock income ...	54.92	100.28	53.00	71.08	100
Livestock bought	12.80	18.10	24.40	16.94	
Feed expenditure ...	13.08	23.70	33.60	20.83	
Net livestock income ...	29.04	56.48	5.00	33.31	

Income and Expenditure

The gross income per family averaged $580, ranging from $450 among the small farmers to $770 among the large farmers. Wages account for nearly half (48 per cent.) the gross income, the small farmers being especially dependent on this source of income (Table 19).

The earnings per man-day on outside employment averaged $1.43*. The earnings per *available* man-day from the farm averaged $0.61 (Table 20). These two rates are not, however,

Table 19

Income and Expenditure

Per holding	A Small $	B Medium $	C Large $	All $
Crops consumed ...	58.14 (13%)	96.00 (15%)	128.16 (17%)	85.09 (15%)
Livestock consumed...	22.49 (5%)	47.27 (8%)	44.07 (6%)	35.53 (6%)
Crops sold	85.29 (19%)	144.27 (23%)	275.79 (35%)	143.10 (25%)
Livestock sold ...	32.43 (7%)	53.01 (8%)	8.93 (1%)	35.55 (6%)
Wages from outside employment ...	252.53 (56%)	296.36 (46%)	313.67 (41%)	280.02 (48%)
Gross income ...	450.88 (100 %)	636.91 (100 %)	770.62 (100 %)	579.29 (100 %)
Crop expenditure ...	41.90 (10%)	58.15 (11%)	116.80 (16%)	62.20 (12%)
Capital expenditure ...	15.81 (4%)	40.60 (8%)	36.40 (5%)	28.67 (6%)
Rents	14.93 (4%)	24.05 (4%)	39.91 (6%)	23.00 (4%)
Crops and stock consumed ...	80.63 (21%)	143.27 (26%)	172.23 (24%)	120.62 (24%)
Expenditure at shop	171.34 (43%)	178.36 (33%)	210.46 (31%)	181.38 (36%)
Other household and personal expenditure	70.20 (18%)	95.96 (18%)	133.82 (18%)	91.69 (18%)
Total expenditure ...	394.81 (100 %)	540.39 (100 %)	709.62 (100 %)	507.56 (100 %)
Difference between total income and expenditure ...	56.07	96.52	61.00	71.73

* Earnings of agricultural male labourers pre-War averaged about 50 cents per day.

comparable, for the man-days *available* for the farm include all week days not spent on outside employment or household duties, or lost through illness. It was found impracticable to ascertain the number of man-days actually worked on the farm. It is of interest to note that the net income per available man-day from crops alone (*i.e.* ignoring income from livestock, which may be swollen by realisation of capital), rises from 37 cents among the small farmers, to 50 cents among the medium farmers and to 63 cents among the large farmers.

The net income per acre from crops is greatest ($39 per acre) among the small farmers and least ($23 per acre) among the large farmers, and the differences in earnings are due primarily to differences in acreage cultivated. The small farmers had 126 man-days available for each acre they cultivated, compared with 70 man-days in the case of large farmers. The total net income from all sources per person (29) per day averaged 25 cents (Table 20).

Table 20

Net Income per Man-Day

Group	Small farmers	Medium farmers	Large farmers	All farmers
	$	$	$	$
Net income from produce* per man-day available for work on the holding ...	.45	.70	.69	.61
Net income from crops only per man-day available for work on the holding ...	.37	.50	.63	.47
Wages per man-day spent on outside work	1.39	1.51	1.39	1.43
Total net income per day per person living on the holding ...	.24	.27	.25	.26

* Including livestock and livestock products.

Food accounted for three-fifths of the total expenditure. Two-fifths, by value, of the food consumed was home produced, the small farmers producing a smaller percentage (32 per cent.) than the medium (45 per cent.) and large farmers (45 per cent.). Expenditure on hired labour, feeding stuffs, etc., averaged $62 per family, ranging from $42 among small farmers to $117 among large farmers (Table 19).

Indebtedness

Indebtedness is not an important problem among these families. One-third (32 per cent.) of them claimed to be free of debt, more than half were indebted for amounts not exceeding $60,

(29) The number of adult male equivalents was not calculated.

Table 21

Indebtedness

	A Small farmers	B Medium farmers	C Large farmers	All farmers	Per cent. of total in debt
No. of farmers in debt ...	22	20	11	53	100
As per cent. of all farmers ...	63	72	73	68	
No. of farmers owing to:					
1. Shopkeeper	17	17	8	42	54
2. Private individuals (no interest)	3	2	2	7	9
3. Private individuals (at interest)	2	2	1	5	7
4. Co-operative Society	2	2	2	4	5
Average debt per debtor in $ ...	25	33	97	43	

and only five (5 per cent.) owed more than $100. The village shopkeepers formerly supplied food, etc., on credit, but usually required part payment at fortnightly intervals, and the annual liquidation of all accumulated arrears during the crop season. Large farmers were allowed credit for amounts sometimes exceeding $200. The debtor was under no obligation to market any of his crops through the shopkeeper. Shopkeepers have experienced no difficulty in disposing of their goods since the war, and two years ago they ceased extending credit except to the wealthiest farmers. Most of the debtors owe the shopkeepers small amounts of long standing which they are in no hurry to liquidate, partly because no interest is charged.

Some (9 per cent.) of the farmers borrowed from friends to whom no interest is paid. Such loans may be for as much as $200. Only 5 farmers (6 per cent.) held private loans bearing interest. The Co-operative Society provides credit only for productive purposes. The sugar companies interested in the district have discontinued the practice of making loans to cane farmers. None of the farmers had mortgaged his land. Most of the farmers found 1942/3 a prosperous year, and many (47 per cent.) expended part or all of their surplus cash on religious feasts or wedding ceremonies.

Co-operation

A Co-operative credit society was formed on May 4th, 1942, near Chin-Chin village, and now has 20 members. Government charges interest at the rate of 3 per cent. per annum on loans it makes to the Society, and the Society charges members 7 per cent. Loans totalling $685 were

granted to members during the year, in amounts varying from $15 to $90. Loans are granted only for such purposes as the acquisition of livestock or agricultural implements, or for the cultivation of crops. Applications for loans must be made at the beginning of the financial year (in June) and require the approval of the Committee and of the Co-operative Officer. The loan from Government was not received until 23rd September, and it seems desirable that the process should be accelerated. Loans are repayable before the end of the following May, and all were in fact repaid. The liability of the members is unlimited.

Summary

(1) Sangre Grande Silty-Clay is agriculturally by far the most important of the four principal soil-types in the Las Lomas District. Bush-fallowing is practised on Talparo Clay soil and on one phase of Piarco Sand-on-Clay, but there is no cultivation on Arena Sand Soil. All four soils are deficient in nutrient elements and their reaction is very highly acid.

(2) The village of St. Helena, which has a pipe-borne water supply, is the most thickly populated part of the district. Main roads are good but traces are in bad repair. Most of the population is Hindu.

(3) The period studied, July 1st, 1942, to June 30th, 1943, was abnormal. Military bases provided abundant and highly paid employment, and shipping difficulties resulted in high prices for local ground provisions, but the price of sugar cane, the principal cash crop, had not risen proportionally.

(4) The 78 farmers examined were classified according to the number of acres cultivated, the means being:—A, small (2 acres); B, medium (4 acres); and C, large (6.5 acres).

(5) One-third of the man-days of labour were spent on outside employment, and about half were available for work on the farm. Income from wages averaged $280 per family and accounted for half the gross income. Nearly all farmers hired some casual labour.

(6) Most of the cultivated land was formerly under cacao. Two-thirds of the land is owned by the farmers. Most (92 per cent.) of the farms are divided into two or more separate parcels of land. Considerations of health justify a separate rice plot, but further fragmentation is uneconomic. Nearly half the farmers reside on the land. Practically all rented land, but only one-sixth of the freehold land was under cultivation. Only one-eighth of the farmers applied farmyard manure.

(7) Sugar cane (half of it interplanted with ground provisions) occupied three-fifths of the cultivated land, and was the only cash crop of importance. Rice and ground provisions each occupied one-fifth of the cultivated land. Cane farmers give less attention than do estates to their cane cultivation. The delivery of cane to the buying points is inadequately organised, and involves great waste of time by carters and animals. Rice is almost exclusively a food crop. The farmer gives greater attention to rice than to any other crop. Ground provisions were formerly grown only for family consumption, but promised to become an important cash crop under war conditions.

(8) Two-thirds of the farmers keep draught animals (for carting cane) and three-fifths of them a cow or calf. Little of the milk is sold. There are three grazing grounds available to peasants paying agistment fees. Cane-tops and grazing on rice land are available during the dry season. Few farmers keep goats or pigs, but most of them keep poultry.

(9) The gross income per family averaged $580. The net income per person averaged 25 cents per day. There is no serious burden of indebtedness among these families. There is one recently formed Co-operative society in the district.

CONVERTED RICE

Converted Rice, which was first produced by Gordon Howell and Eric Huzenlaub, is a white rice that is a complete food. Ordinary rice which is stripped of a large portion of its nutrients by the process of manufacturing reaches the buyer as almost pure carbohydrates, but converted rice retains up to 80 per cent. of the vitamins and minerals of unmilled rice.

In the Huzenlaub process, the unmilled rice is cleaned and placed in a vacuum tank where the air is sucked out of the grain. Hot water at extremely high pressure is forced into the emptiness thus created. The B vitamins, being soluble in water, are pushed into the centre of the grain. Steam is applied to seal them there. When the rice is dry, milling machines remove the husk and skins, leaving tough, cream-coloured kernels whose nutrients cannot be rinsed away.

Converted rice, as shown by exhaustive tests, will keep without deterioration for years in all kinds of weather. Weevils, which cost millers millions annually, cannot get at these hard, glassy kernels. At the end of 20 to 30 minutes of cooking, the kernels emerge with a pleasing separateness and will remain that way after a night in the refrigerator.

Dr. M. C. Kik, rice chemist to the University of Arkansas, attested in the *Rice Journal* that the vitamin B content of converted rice was twice to three times that of polished white rice. The sponsors believe that the conversion method can be applied to virtually all cereals. With it Huzenlaub has produced a full-vitamin wheat and has experimented with barley and homing grits. Another feature of the process is that vitamins and minerals not present in natural rice, wheat or other grain can be injected into these foods.—(Abstracted from *Reader's Digest*, Feb., 1944.)

SOILLESS CULTURE OF PLANTS*

This modern venture into intensive horticultural practice provides a complete contrast with soil culture in which the supply of water is a factor of such great importance. In soilless culture water is scarcely a contributory factor at all, since it is supplied artificially at whatever rate may be desired. The problems here centre around the nature and proportion of the nutrients dissolved in the water and the manner in which the water is conveyed to the roots. Recently, much has been done by way of critical examination of the commercial prospects of the process and in many cases the scale of experiment has been considerable. Indeed C. Y. Arnold (1) in a short discussion of current developments refers to two American growers having 10,000 and 12,000 feet respectively of glass-house actively engaged in the market production of fruit and vegetables without a grain of soil being used. Many workers (2) emphasise the vital importance of aeration of roots growing in nutrient solutions. This factor appears to operate in favour of methods in which a solid substrate is used as against those in which the roots are always immersed in a nutrient solution however well that solution may be aerated by air-bubbling.

W. G. Templeman and S. J. Watson (3) have reviewed current methods adopted both for indoor and outdoor culture, and Templeman reaches the conclusion that soilless culture of plants is economically safe for high-priced greenhouse crops. S. Kasugai (4) describes methods satisfactorily adopted in Japan for the culture of melons, ground-nuts, and various root crops. Flower production too can be carried out effectively by this means (5). R. H. Stoughton (6) favours the sub-irrigation system in vessels filled with gravel, cinders, or even coke. The solution is pumped at intervals into the culture vessel from which the surplus drains back again into the solution tank. The use of sand as a filling for the culture vessels, while providing an excellent medium for the ramification of roots apparently involves considerable cost owing to the retentive capacity of the sand for the nutrient solution. In a consideration of the composition of the nutrient solution, Stoughton not only emphasises the importance of supplying the right materials in correct proportions but also stresses that the pH of the nutrient must be maintained within a suitable range characteristic of each species. Differential absorption of acid and basic ions by the plant effects a gradual change in the pH during growth.

By careful choice of physiologically "acid" and "basic" components, solutions may be prepared in such a way that pH changes during the growth of the plant are small. In this way the wastage of nutrient and also the adverse effects of an unsuitable reaction are simultaneously avoided. In a later paper Stoughton (7) adds further confirmation of his earlier observations and describes a nutrient solution which gives good results with materials available under present conditions. A point of additional interest recorded is that analysis of tomatoes grown in soilless culture shows these to have the same nutritional value (including vitamin-C content) as fruit grown in the soil. It would appear from the work of D. I. Arnon and D. R. Hoagland (8) that the productive capacity of tomato plants is the same whether the plants are grown in soil or in solution cultures. The elimination of disease in solution cultures is relatively simple compared with that in soil cultures. Hayes (*loc. cit.*(2)) reports that development of mould on pea and lettuce seeds is entirely prevented by treatment with 0.5 per cent. solutions of thiourea.

It is to be inferred from recently published data that this interesting innovation in horticultural practice is worthy of commercial exploitation provided that it is in the hands of highly skilled workers, that very close observation of growth is maintained, that careful control of the nutrient media is assured, and that relatively high-value horticultural crops are selected. The testing and adjustment of the nutrient solutions are matters of no small concern. The optimal concentrations of individual nutrients are not necessarily the same throughout growth. Weather conditions (especially the number of hours of sunshine) also affect the character of growth of the plants and as a consequence their nutrient requirements. To what extent it is necessary or profitable to consider this ever-changing requirement of the plants cannot yet be decided. If it should be so, then the supervision of a soilless market garden may indeed become a formidable task even with a system of rapid testing methods. Even if this should be proved unnecessary, there still remains much for a technical supervisor to deal with, and the glasshouse may well become a closely controlled factory. This may not be in any sense derogatory. The production of food is worthy of our highest technical skill, and this recent modification of technique appears to be passing through its testing period with every prospect of success.

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* (Extract from an article by A. G. Pollard in the *Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry*, Vol. XXVII.)

CHEMICAL NOTES

(Compiled by the College Department of Chemistry and Soil Science)

Classifying Land for Conservation Farming

According to the *U.S.D.A. Farm. Bull.* No. 1853, the four main factors in conservation land classification are the nature of the soil, the degree of erosion, steepness of slope and climate. A land map for conservation planning "must be more than a soil map, an erosion map or a slope map; and yet it must be simpler than any of them". A simple classification now being used throughout the United States is described, in which 8 land-capability classes are distinguished according to the intensity of use that can be safely practised and the measures or restrictions necessary to prevent erosion. The classification is particularly applicable to soil-conservation districts.

* * *

Utilization of Bamboos in India

In a Utilisation brochure issued by the Forest Research Institute, Dehra Dun (*Indian For. Rec., For. Res. Pub., Dehra Dun*, 1943). V. D. Limaye describes some investigations into "Bamboo Nails, their Manufacture and Holding Power". The investigation was commenced owing to the fact that wire nails had become very difficult to obtain in India, while the demand for packing cases, not least for army requirements, had increased enormously. Experiments were carried out to see how bamboo nails compared in holding power and other qualities with wire nails. The results of the tests are given and sketches of large-scale production of bamboo nails are included and the process of manufacture described. "It has been found", says the author, "that glued bamboo nails have a greater holding power than plain iron nails under a steady pull. But when shocks and transportation hazards are met with, their holding power diminishes". A small percentage of iron nails in a packing case is, therefore, necessary, especially for fixing the battens by clinching. It was found by actual tests that if 25 per cent. iron nails and 75 per cent. bamboo nails are used, a strong and serviceable box results, with a very considerable saving in costs of manufacture.

Another use of the bamboo has been found in the manufacture of pill or ointment boxes. Due to a shortage of metal, various substitutes have had to be used in the construction of containers; thus plywood has already been mentioned in *Nature* (*Ind. For. Leaf.* 24 and 26). In Leaflet 39 (1943), Sultan Mohammed discusses the method of making from bamboo small pill and ointment boxes. Details of manufacture are given including some information on suitable coatings and linings. It is said that a fairly competent turner will find no difficulty in making these boxes with the aid of a lathe and ordinary tools. The description is of interest: "A bamboo container consists of a short length of bamboo (according to size of container required) which forms the walls of the body and lid of the container. The top and the bottom are made of thin three plywood and are provided with a locking device so that, if the top becomes loose due to climatic changes, the lid will still be held tight. The container is usually coated or painted, both inside and outside, with the object of retarding the absorption of moisture by sealing the pores of the bamboo, and to give a smooth clean finish."—(*Nature*, Vol. 152, No. 3869).

* * *

Stability of Soil Crumb in Uganda Soils

Water-stable crumbs exceeding ½ mm. size were found to be an efficient indication of soil structure and consequent inherent fertility. The Tiulin technique was applied to a number of fertility experiments, and it was found that farmyard manure merely feeds the crop and has no effect in re-forming the structure of the soil. In the experiments where resting periods are included it was found that resting under grass regenerates the fertility of the soil by building up the crumb structure to a high level before cropping. It was possible to construct a tentative empirical scale showing the relation between the percentage of particles over ½ mm. and the fertility level of the soil. In Buganda, red loam soils which had rested under elephant grass attained about 60 per cent. of these crumbs; in the short grass areas, well-rested silt loam soils attained about 40 per cent. These percentages declined steadily with cultivation, falling as low as 30 per cent. after continuous cultivation in both areas and 20 per cent. if the destructive process is assisted by erosion. These results provide for the first time proof that, under local conditions, the resting period under grass does regenerate the structure of the soil and that manure does not, thus supporting the earlier field observations which led to the adoption of the grass resting period in 1934.—(*Soils and Fertilizers*, VI, No. 4, p. 169.)

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Fertilizer Value and Wax Content of Filter Cake

Chemical analysis of dry filter cake from 21 factories in Natal and Zululand show the following average composition: total nitrogen 0.81, available phosphate 2.50, available potash 0.10, available calcium oxide 13.69 and available magnesium oxide 0.79 per cent. The nitrogen content ranges between 1.17 and 0.63 per cent. which compares favourably with Karoo manure and still more favourably with composts. All these cakes contained cane wax (extracted with benzene) in amounts ranging from 0.59 to 12.80 per cent. As a rule (with exceptions) cakes from Oliver filters have the least wax owing to the large amounts of bagacillo used as filter aid.—(*Chemical Abstracts*, 1943, Vol. XXXVII, No. 2, p. 494.)